



DESIGN OF DOUBLE C SLOT MICRO STRIP PATCH ANTENNA FOR Wi-Max APPLICATION OPERATING AT (3.2-3.8GHz)

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ABSTRACT

The antenna is transducer device which converts electrical signal into electromagnetic signal. Antenna is used for communication purpose for transmitting and receiving waves. In today life communication devices become very thin and smarter like mobile phones. It requires higher bandwidth where the micro strip patch antennas are better as compared to other antennas. The double C slot micro strip patch antenna is used for Wi-Max application. The Wi-Max is nothing but worldwide Interoperability for Microwave Access has been established by IEEE 802.16 standards.

In Wi-Max there are three frequency bands like upper band, middle band and lower band. The design of antenna at middle band frequency for Wi-Max application. The frequency of middle band is 3.2-3.5GHz. Theoretically coverage area of Wi-Max is up to 50km radius and speed of the Wi-Max is up to 70Mbps.

KEYWORDS: Micro strip antenna, IE3D Software, VNA, Wi-Max.

I) Introduction:

The micro strip patch antennas have more advantages. The study on micro strip patch antenna has made a great progress as compared with other antennas. The next generation networks require high data rate and devices are small in size. There are two important standards are Wi-Fi and Wi-Max. Wi-Fi is nothing but WLAN. These application the need of small and efficient antenna. The wireless communication have more importance in today's life. Micro strip antennas have different characteristics like low profile and low cost. which proves micro strip antenna to be well suited for Wi-Max application system.

A micro strip antenna consists of radiating patch on one side of dielectric substrate which has a ground plane on other side and it is shown in fig 1. The patch is made of conducting material like copper or gold and can take any type of shape which is shown in fig 2. The micro strip feed line and the radiating patches are usually photo etched on the dielectric substrate. there are different types of dielectric substrate like Bakelite, FR4 glass Epoxy, RO4003 RT Duroid and Taconic TLC. We are using FR4 (flame redundancy type 4) dielectric substrate and the height of dielectric substrate is 1.6mm. For better antenna performance, a thick dielectric substrate having low dielectric constant is desirable since this provides better radiation, better efficiency and also large bandwidth.

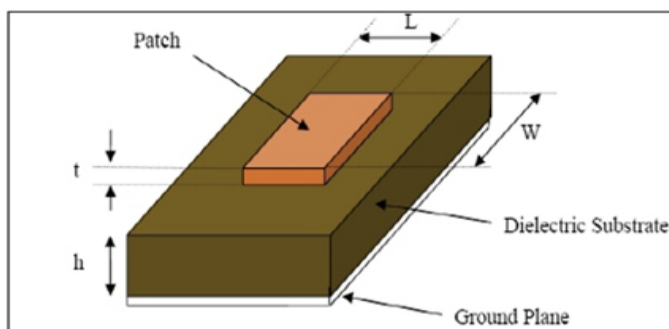


Fig1. Structure of micro strip antenna.

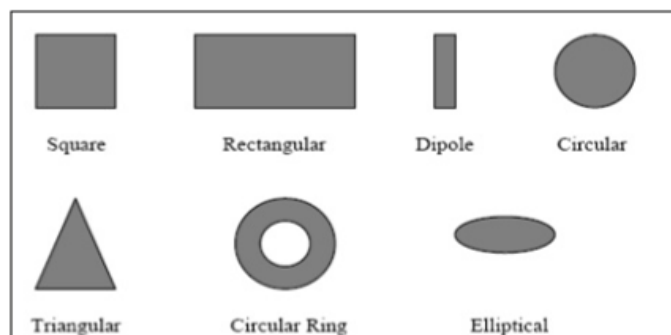


Fig2. Different Shapes of MSA Patch.

II) Objective:

1. To design, simulate C slot micro strip patch antenna at 3.5 GHz for Wi-max applications.
2. To design, simulate, fabricate and validate the performance of double C slot micro strip patch antenna at 3.5 GHz for Wi-max application.
3. Return loss, VSWR, bandwidth enhancement by designing new double C slot micro strip patch antenna.
4. To investigate behavior of antenna and analyze various parameter of antenna to improve return loss and bandwidth.

III) Feeding Technique:

A feed is used to excite to radiating patch by direct or indirect contact. The feed of micro strip antenna can have many configurations like micro strip line, coaxial, aperture coupling and proximity coupling, but micro strip line and the coaxial feeds are relatively easier to fabricate. Coaxial probe feed is used because it is easy vary the input impedance of the coaxial cable in general is 50 ohm. There are several points on the patch which have 50 ohm impedance. We have to find out those points and match them with the input impedance.

IV) Methodology:

In methodology there are different steps like data collection, calculation, simulation, analysis, Fabrication, testing, validation, re-fabrication etc.

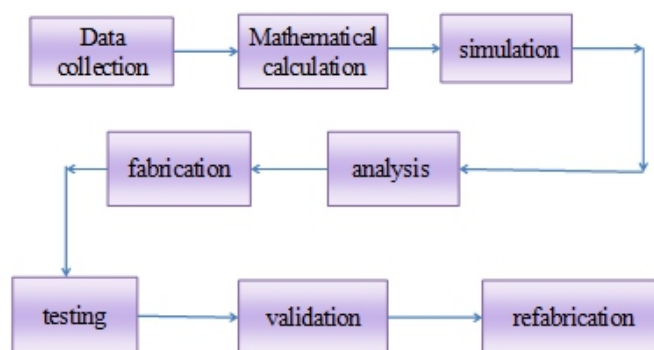


fig3. Methodology of MSA

a) Data Collection: We have collecting the information about micro strip patch antenna & also collecting the literature survey about this project. In MSA which dielectric material is better for analysis & also collecting the data about fabrication, testing, analysis.

b) Mathematical Calculations:

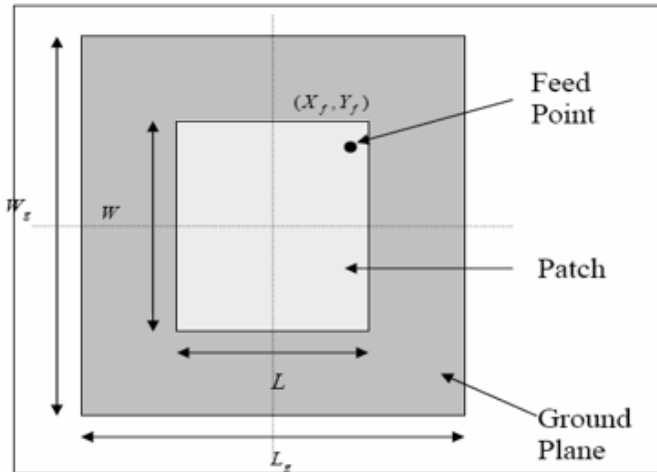


Fig4.Parameters of mathematical calculations.

- Calculation of the width (W)
 $W = \lambda_0 / 2\sqrt{\epsilon_r}$
 Substituting $\epsilon_r = 4.4$ and $f_0 = 3.5$ GHz.
 $W = 20.43$ mm.
- Calculation of the length (L)
 $L = W = 20.43$ mm.
- Calculation of the ground plane dimensions (L_g & W_g)
 $L_g = 2(6h + L)$
 $W_g = 2(6h + L)$
- Length L_t & width W_t of micro strip line feed.
 Total length of feed (L_t) = length of
 Feed $\left(\frac{\lambda_0}{4}\right) + \text{inset length}(Y_0)$.

c) Simulation Software:

IE3D (Integral Equation 3D)



Fig5.IE3D Software.

We are using the IE3D software because this software is easy to analyze & also fabrication is easy. Some of IE3D's features like,

- Efficient matrix solvers.
- 2D and 3D display of radiation pattern and also near field.
- High efficiency, low cost and high accuracy.

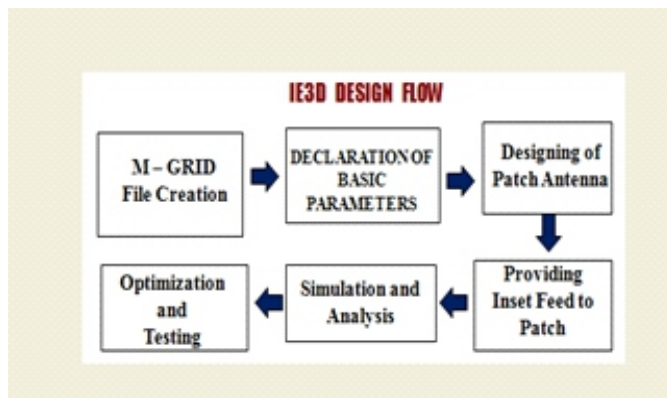


Fig6.Design flow of IE3D Software.

- In this design flow diagram first select the M-GRID then click on the new file. Then declare the basic parameters.
- Select Rectangle shape; determine the length and width of the patch. Design the double c slot shape on the patch.
- Insert the micro strip feed line and ground plane.
- Select process options, then click on simulate.
- check the simulated result, if correct result no need of analysis process.
- Fabrication of antenna.
- Testing of fabricated antenna by using vector Network Analyzer.

d) Analysis:

In analysis process the different parameters like a, b, d, w, v, L. These parameters are changing for Improve Gain, VSWR, Band width, and Return Loss.

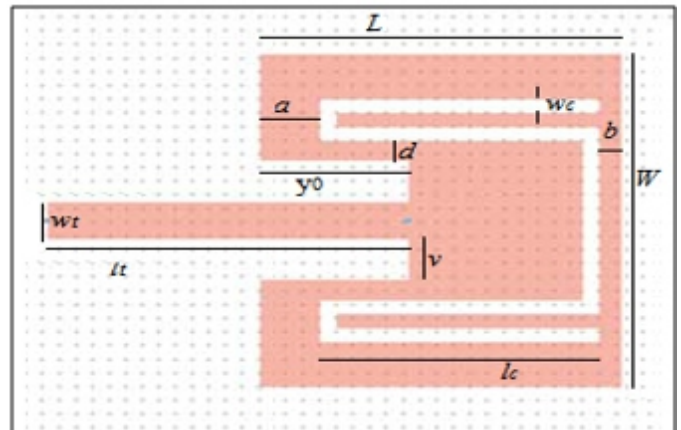


Fig6. Parameters used for analysis.

Parameters of antenna:

There are different parameters measured by using antennas like VSWR, Antenna gain, return loss, directivity, antenna efficiency and bandwidth of antenna is analyzed.

- Gain:** The gain is defined as the ratio of the intensity in a given direction to the Radiation intensity that would be obtained if the power accepted by the antenna were radiated. Isotropically. Formula for gain is $G = 4\pi \cdot U(\theta, \phi) / P_{in}$, where, $U(\theta, \phi)$ is a intensity in a given direction, P_{in} is in put power.
- Radiation pattern:** The radiation pattern is observed by using different kits like microwave
- Antenna efficiency:** It is a ratio of total power radiated by an antenna to the input power of an antenna.
- VSWR:** Voltage standing wave ratio is defined as the ratio of output voltage to the input voltage. It is mathematically given by,

$$VSWR = V_{max} / V_{min}.$$

It should lies between 1 and 2.

- Return loss:** Return loss is the reflection of signal power from the insertion of a device in a transmission line. Hence the RL is a parameter similar to the VSWR to indicate how well the matching between the transmitter and antenna has taken place. The RL is given as by,

$$\text{Return Loss} = -20 \log_{10}(\Gamma) \text{ dB.}$$

where as a $\Gamma = 1$, $RL = 0$ dB.

For perfect matching between the transmitter and the antenna, Reflection Coefficient = 0 and should be Return Loss should be equal to -∞.

e) Fabrication:

In fabrication there are different Steps we have seen.

- Generate mask on transparency:** 1st step to transfer the EM structure from microwave office software to AutoCAD and print it onto the transparency film.
- Photo exposure process:** 2nd step is photo exposure process it is nothing but UV exposure process. It is done to transfer the image of the pattern with a film in a UV exposure machine onto the photo resist laminated board. The process is taken about 2 minutes.

- iii. **Etching in developer solution:** 3rd step is to ensure the pattern will be fully developed, during the developing process. The photo developer solution was used to wash away. The expose resist for about 10minutes then the solution was removed by spray wash.
- iv. **Etching in Ferric Chloride:** 4th step is etching in ferric chloride. It will remove the unwanted copper area and this process took about 30minutes.
- v. **Soldering the probe:** 5th step is soldering the probe where the board was rubbed with sand paper to remove the remains of the unexposed resist pattern area upon fabrication, the SMA connector was soldered to the MSA. We are using SMA connector because it requires high coefficient and tight connection.



Fig7. Fabrication of MSA.

f) Testing:

In this step testing is done by using VNA Kit. VNA is nothing but Vector Network Analyzer. VNA kit is used for observe the graph of VSWR, Smith Chart and Return loss etc.

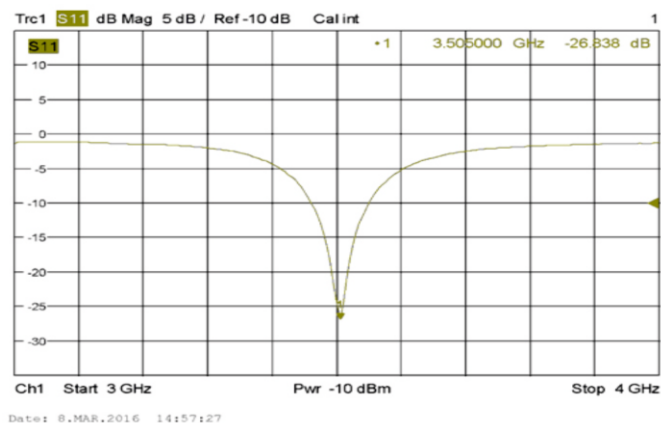
g) Final Result:**1. Return Loss.**

Fig8.Graph of Return Loss

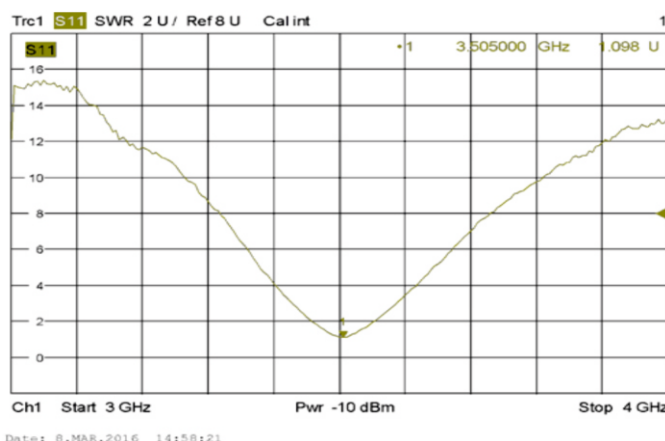
2. VSWR.

Fig8.Graph of VSWR

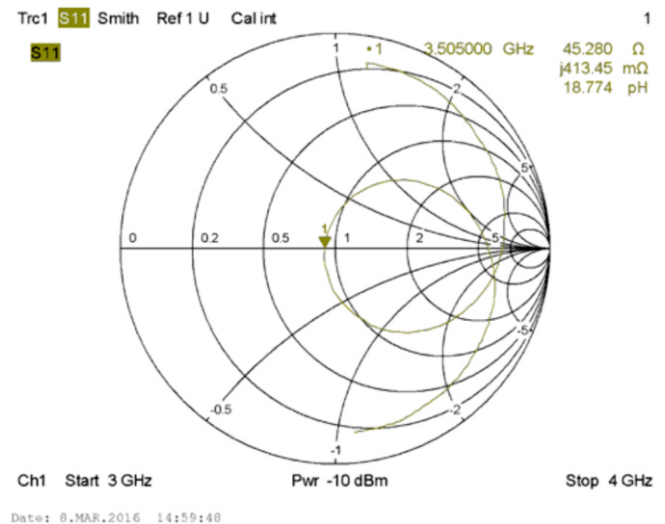
3. Smith Chart.

Fig8.Graph of Smith Chart

h) Advantages:

1. Size of antenna is small.
2. Weight of antenna is light.
3. Antenna is Easy to install.

i) Disadvantages:

1. Efficiency of antenna is low.
2. Gain of antenna is low.
3. Power handling capacity of antenna is low.

j) Applications:

1. In mobiles.
2. In laptops.

k) Conclusion:

A Double C slot antenna has been proposed to radiate in the upper limit of Wi-Max frequency range of 3.2-3.8 GHz. The Return loss is -26.338 dB, VSWR=1.098 at a resonant frequency of 3.5GHz.

REFERENCES:

- 1) Design of Double C slot Micro Strip patch antennas with Defected Ground structure for Wi-Max N.R. Ingale, 2S. B. Deosarkar, 3V. U. Deshmukh IJCT Vol.3, Issue 4, Oct-Dec 2012.
- 2) TiliBoutheina,"Design of double C-slot Micro Strip patch antenna for Wi-Max application," APSURSI, PP 1-4, IEEE.2010.
- 3) K.P.Ray, Broadband Micro strip antennas, Aretch House, First edition.2003.
- 4) Constantine A. Balanis, Antenna Theory, Analysis and Design, John Wiley Sons Inc.
- 5) Design and Analysis of Micro strip-Fed Band Notch UWB Antenna G.karthikeyan1, c.Nandagopal.M.E2, International Journal of Computational Engineering Research Vol1, 03 Issues, 4 April, 2013.
- 6) A Compact dual inverted C-Shaped slots antenna for WLAN applications References D.Xi,L.H.Wen, Y.Z.Yin,Z.Zhang, and Y.N.Mo National Laboratory of Antennas and Microwave Technology Xidian University Xi'an, Shaanxi710071, P.R.China Vol.17, 115123, 2010.
- 7) High Gain of C shape slotted Micro strip patch Antenna for Wireless System, Anamika Singh1, Aadesh Arya2 Sanjay Sharma3, International Journal of Applied Engineering Research, ISSN0973-4562 Vol.7 No.11 (2012) if applicable.

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